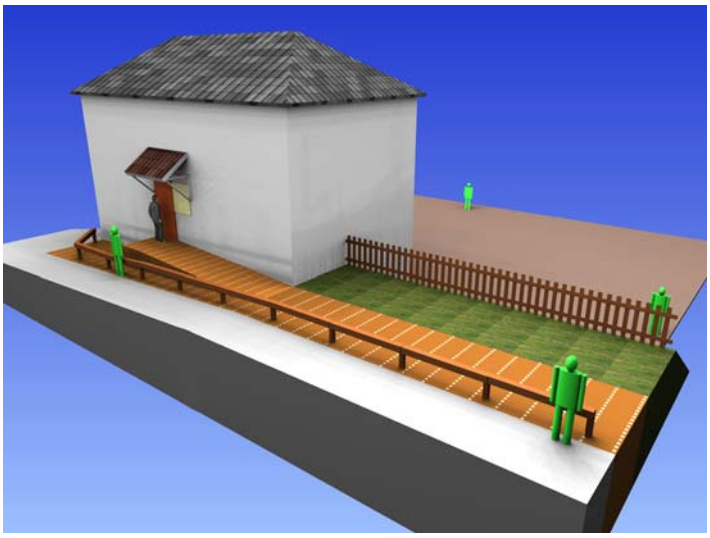
Finding 'the 3D Way'

Independent consultant Simon Lambert describes the use of 3D computer-aided design to help end-users and suppliers.

Unfortunately, it's not an uncommon cry from owners of CCTV systems: "Why don't my pictures show me what I want to see?" Many pages have been devoted to what happens to the images between leaving the camera and appearing on the screen before your eyes. So rather than concentrate here on picture quality or recording methods, instead, we'll step back to square 1 and spend a few moments looking at some innovative ways to solve a perennial and fundamental problem: how to get the correct views from the cameras in the first place.

Sowing the seeds of a disappointment

When a CCTV camera installation is sold there is an all too common risk lurking beneath the 'bonhomie' between the customer, his consultant (if he employs one) and the salesman. Take a moment to consider a familiar situation. In the customer's mind's-eye, or more worryingly that of their boss and the CCTV financier, the equipment that they've ordered is sure to provide them with pictures showing the subjects that they are interested in, across the territory that concerns them, and in sufficient detail to suit their intended purpose, e.g. identification of people, etc. Unfortunately, unbeknown to the end-user this ideal differs from that in the mind's-eye of the salesman who designed his 'keenly specified' system complete with the canny sales pitch. This salesman (possibly) knows that you can't expect a wide-angle lens on the one static camera in the car park to survey everything *and* read vehicle index numbers 50 yards away. He might assume that this limitation is plain to anyone. Surely his new customer isn't expecting such an obviously unreasonable capability. Is he?



Single-handed, this site took only a few hours to measure and create as a scaled 3D computer model. The green figures are human-sized (1.6m) illustrate various camera views to the client.

Now I hear some of you cry, "What do you expect without a properly designed Operational Requirement?!" Alas, with many folks the need for this vital step goes unappreciated. Of the many non-specialists who have responsibility for CCTV foisted upon them, only a few ask an impartial CCTV expert to help them at the early stages so that they don't buy a pig-in-a-poke. Let's not forget that the layman customer is a classic example of someone who 'doesn't know what he doesn't know'. In other words, he is blissfully unaware that his ignorance of the intricacies of CCTV design and implementation threaten to trip him up further down the line. In this way, the seeds of a future bust-up are sown between end-user and supplier. Murphy's Law ensures that these seeds will grow to bear fruit after the customer suffers a loss that brings the inadequacies of the CCTV into sharp focus (forgive the deliberate pun).

This model can predict the view from a 12mm lens + camera in the top right corner. Field of view, %Rotakin, etc. are clear even to a non-technical client, unlike relying on plans & written specifications.

However, let's not forget the point of view of the salesman who may be reluctant to design and quote a properly engineered system. Why? Because he fears that rival salesmen may compete for the contract by producing a cheaper bid with concealed inadequacies that go unchallenged because of the customer's naïvety. Any thoughts he entertains that the gullible customer will eventually get his just desserts are of little consolation to a salesman whose income, and maybe even his job, are threatened when he loses the contract to his less conscientious competitor. The salesman or sales support engineer are often under pressure to complete the design and proposal very quickly and consequently it may lack sufficient attention to detail for such misunderstandings to be avoided. These last few issues are known only too well to me, as I spent several years early in my career as an engineer in a sales role.

A modern solution to an old problem

As an independent consultant for many years, a background in physics and electronics brings a body of knowledge to my poacher-turned-gamekeeper role that is vitally different from that of the myriad consultants around the CCTV industry who are, for instance, ex-policemen or ex-managers hired where they appear to be just a little bit more technical than their customer. But, having taught many a BTEC level 4 course in CCTV Consultancy for several years, it is clear that often they too 'don't know what they don't know'. Salesmen's tactics will time and time again be to pull the wool over their eyes. Strong concerns over the issues described above led to me developing new ways to help defuse the misunderstandings that result in much disappointment, mistrust, wasted time and money.

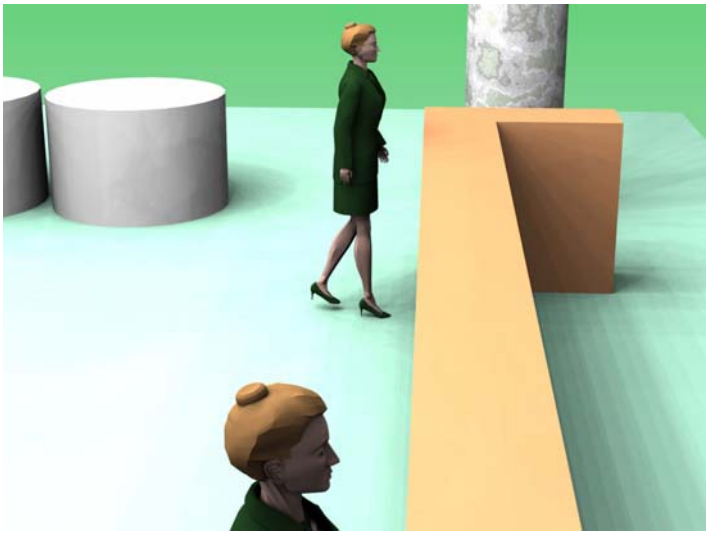
The rest of this article will discuss methods that I have developed in an attempt to avoid the problems described for the perplexed customer, his consultant, and the sales engineer. The techniques use computer generated 3D graphics to reconstruct a scale model of the CCTV site. From this the customer can *see* the virtual-reality views from the proposed cameras before they are agreed. A picture is so much easier for the non-expert to comprehend than a tranche of technical jargon. Many people, and many experts too, pretend to understand in order to save face. They might carry this exercise out with their consultant and write the agreed design into the tender specification (including the images). The salesman and designer might use these methods when working directly with the customer to agree each field-of-view prior to signing a contract, so that future disputes between them on these issues may be avoided. Indeed, the smart salesman can use these methods to *objectively* demonstrate to his prospective customer the shortcomings of his rival's bid, whereas simple words might simply be heard as hot air and would not be believed.

A supplier claims that their proposal will identify vehicles. With this lens and a 288x384 pixel image simulating DVR or VHS playback, the number plate is magnified (inset) and, clearly, is unsatisfactory.

So often, seeing is believing. A salesman who can actually *show* that his proposal achieves what they wish for and, importantly, can demonstrate that his rival's actually does not, can secure profitable business on its merits, and at a better price. By the same token, some expensive mistakes during the installation stage might be avoided completely, to the advantage of all concerned.

Bring life to a boring drawing

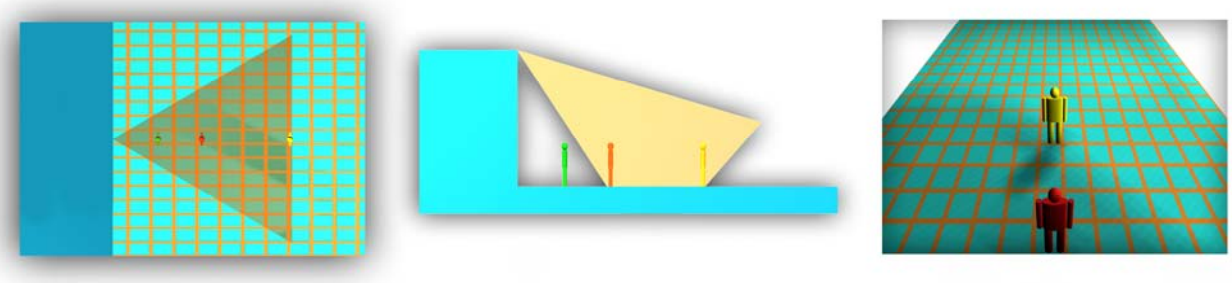
This can be especially useful when working on a new building that doesn't actually exist at the time the CCTV is procured. Architect's plans can be adapted to create a virtual world where 3D CAD drawings have virtual cameras inserted so that the fields-of-view can be calculated by the software and displayed as CCTV frames approximating the real-world views. Quick and easy experimentation with camera locations, heights, orientations, pan/tilt sweeps, and lenses can be performed on a laptop computer in the presence of the design team and the end-user to benefit from their input. This can produce optimum CCTV layouts that are clear to everyone involved. Again, they can be altered easily when requirements change as they inevitably do as the project develops. Where the site already exists it is not uncommon for mobile CCTV cameras to be deployed, e.g. van with telescopic mast, to check camera coverage and actual equipment can be performance tested in a range of lighting situations. However, limitations of time, weather, difficult physical access, especially at height, and expense mean that experimentation in the 3D virtual world still has unique benefits. This is also be true when important stakeholders cannot attend the tests, repeats visits are necessary or when particular targets are not physically available such as Rotakin, vehicles, walking/running people.



This building didn't exist during the CCTV design. The architect had allowed one camera. Could facial 'Recognition' (50% Rotakin) be achieved along all of the Reception desk? Yes; using a 6mm lens.

Dispelling Myths

Non-specialist stakeholders can be helped to appreciate camera siting and fields-of-view, and also to understand the limitations of picture resolution by generating camera images with the same number of pixels as a typical digital video recording. Many customers genuinely believe that the police and NASA can enhance their inadequate pictures when required. After all, such marvels are frequently reported on the television news. If urban myths say that spy satellites in space can read newspapers, and a computer technician in an episode



A two-dimensional plan (above, left) shows that the camera's triangular field-of-view covers the three people satisfactorily, but when we take the rare step of looking at a side elevation (above, centre) the blind spot is revealed. The actual view from the proposed camera is generated by the computer (above, right) so that even non-technical contributors can comment on its suitability.

of 'Spooks' can enhance a small fuzzy blob on a CCTV image, then surely modern technology has no limitations in the mind of the layman CCTV owner. Using these virtual environments the clarity of number plates and peoples faces from *their* proposed cameras can be demonstrated, the limitations that the salesman has omitted to explain can clearly seen and the possibility of disappointment reduced.

The right way to look at the problem

For many years CCTV systems have been designed by using a lens calculator and drawing triangles on site plans. However, basic 2D methods take no account of the effects of mounting the camera several metres above the ground or the vertical tilt and the inevitable blind-spot beneath. In addition, the designer has little information about the height of any features that block a camera's clear line of sight, especially trees. So how do we proceed when 3-dimensional details are not available from the customer? Simple surveying stills can quickly provide the necessary measurements for recreation in the 3D CAD environment. We can simply use a hand-held laser range finder, Abney level (similar to a sextant for sighting vertical angles), magnetic compass and a tape measure. For larger, more complex sites we use our theodolite, and may hire a fully equipped surveying team when economically astute. Alternatively, modern 'photogrammetry' software can create 3D models from carefully aligned 2D photographs, or 3D laser-scanners can capture every nook & cranny of complex scenes and are becoming more commonplace.

Computer visualizations are commonly offered by manufacturers of furniture as a sales aid. To design and picture wider elements of your security project the consultant's graphics skills are important.

Moving on

For many years these techniques have been used in the AEC business (architecture, engineering, construction). The world of CCTV has always had three dimensions, but often designers have chosen to limit themselves to 2D as this very much simplifies their job, but increases design risks. Modern technology offers the tools to do the job properly, and we have actually used these to good effect on a number of projects. There is an indisputable 'wow' factor with the client. We have progressed to the 4th dimension of Time (according to Albert Einstein) and animated the transit of targets through cameras' fields-of-view as this is vital where the gaps in time-lapse recording are such a common feature of CCTV footage and should be taken into account during the design process.

Importantly, another interesting use of the technology involves superimposing lifelike computer generated images of proposed equipment onto real photographs to help with applications for planning permission (below), and to photo-realistically visualize and plan installations such as control rooms (left).

The camera and fittings are computer generated and superimposed onto a photograph using our in-house skills to illustrate a planning application. Our customer thought the installation was completed!

A stitch in time saves nine

It's my belief that time spent using these new and modern techniques at the beginning of a project can help to minimise many types of problem further down the track. The great benefits are that end-users know what they are getting; the installers know that it actually can be done, and the customer can easily check that they got what they were promised before they pay the bill. Some years ago a Mr. T. Blair espoused taking 'the 3D way'. Maybe I misheard him, but I think he would be pleased that the most modern methods are being developed to benefit this important business.

Simon Lambert BSc. (Hons), MASC, is principal consultant at independent practice Lambert & Associates, and is a member of the Association of Security Consultants. For contact details visit: www.lambert-associates.co.uk